

# Indigenization of Track Tamping Machines for Indian Railway



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**Abstract:** This paper gives a diagram of significance and advancement of automation of Indian railroad track support and different kinds of packing machines with their particular capacities which are utilized by Indian rail route for track upkeep. Railroad, being more secure and conservative, has been a favored mode for transportation of travelers and products. For long, the support of tracks were done physically, which was man power riched and tedious as well as had other specialist impediments of trouble in dealing with heavier track structure, constrained work window because of higher recurrence of trains, wellbeing of track upkeep faculty, and unpredictable nature of yield among others. Toward the beginning of automation Indian railroad imported the rail packing machine from plasser and theurer which is an Austrian organization. It is the main organization on the planet that gives a scope of packing machines for support of railroad tracks. At first the attention was solely on machines for track laying, track upkeep and estimating work. During the 1980s the range was reached out to incorporate machines for the establishment and support of overhead lines. From most recent couple of years Indian railroad is chipping away at indigenization of packing machines. For making indigenous machines railroad utilize figuring out system .based on sort of the rail line track (straight track, Curved track and point and intersection track) the packing machine is fabricated.

**Keywords:** Mechanization, Tamping Machine, Overhead lines, Installation, Indigenization, Reverse Engineering.

## I. INTRODUCTION

The track of railway which is also called permanent way consists of rails fasteners sleepers and ballast plus under laying sub grade .The main functions of permanent way and track foundation is to direct the flanged wheel and transfer of loads from rail wheels to the bed capable of sustaining cyclic loading A Tamping machine is outfitted with in any event two Tamping unit with it.

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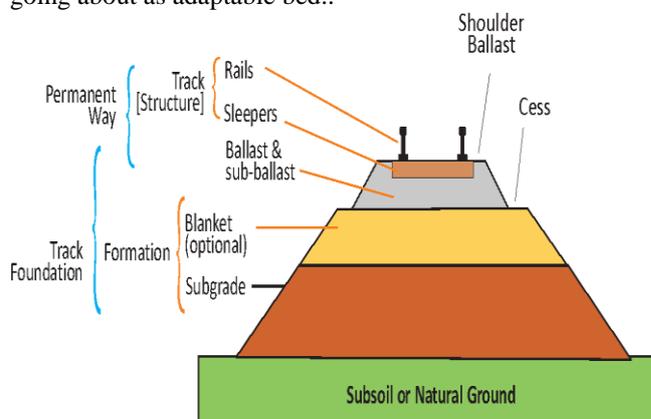
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The pressing In incredible conditions if track geometry isn't as demonstrated by parameters the it will direct impact the trading of weight from moving stocks to the game plan and this will be purpose behind shocking speeding up achieving undermined ride quality. Along these lines it is imperative to control changes in track geometry parameters to diminish consequent nerves. The balance layer underneath the sleepers plays out various limits like trade of weights down underneath, giving insurance from mutilation, squander and going about as adaptable bed..



**Fig. 1.1 – Track cross-section showing its constituents**

This layer similarly offers an amazing vehicle for change of track geometry Because of the above clarification track support is crucial and upkeep is driven time to time or dependent on need to secure that the track must be in proper working condition [1].

## II. MAJOR TRACK GEOMETRY MAINTENANCE PARAMETERS

- A. Tamping on straight /plain track and point and crossing to maintain the track geometry parameter within the limits.
- B. Balancing of ballast bed quickly after Tamping for better retentivity and slower declining of track parameters [2].

## III. MECHANISATION OF TRACK GEOMETRY MAINTENANCE

Till the second half of 20<sup>th</sup> century, the maintenance of track geometry was done manually. Following are some important reasons of switching from manual methods of track maintenance to mechanized method of track tamping -

- A. Beater packing is a tough job and therefore the workers usually abstain from doing this kind of job.

**B.** It isn't anything but difficult to guarantee the uniform nature of the compaction underneath the sleepers when it is done physically implies in light of the fact that every single work has diverse quality, devotion towards work and distinctive factor.

**C.** Another important need of mechanization is increased Traffic densities, axle loads, and daily basis increased train speeds on Indian Railways considerably in the recent past.

**D.** Manual maintenance is not needed now a day because of the heavy weight of the concrete sleeper and heavy welded rails.

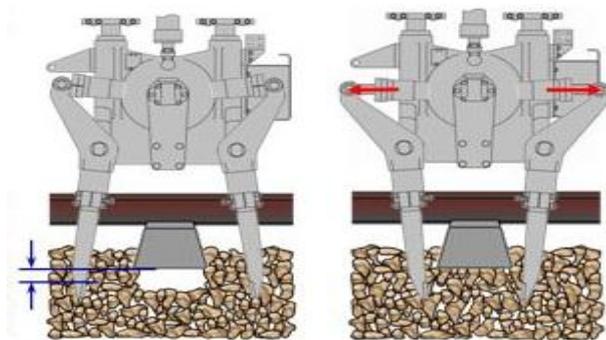
**E.** Manual maintenance of railway track takes too much time which causes restriction of speed for long period of time till the track is renewed after maintenance.

**F.** Automation of track support on Indian Railways after 1960s with import of on-track alters by Swiss organization Matisa, which used to pack each sleeper in turn. In 1965 Austian organization plasser and theurer began selling packing machine to Indian railroad and in February 1968, the first track support machine fabricated in quite a while by M/s Plasser and Theurer was given to Indian Railways. Over a period, number of machines have been sourced from world over and sent on Indian Railway, of which a huge extent has been provided by M/s Plasser India.[3]

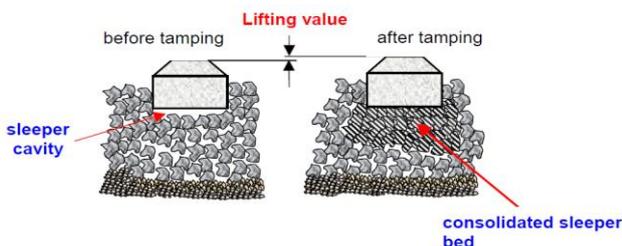
**IV. BASIC TAMING PROCESS**

Tamping is a process for correcting the track geometry or maintaining the correct track position by packing of the ballast under the sleepers and the machine which is used to accomplish this process is known as Tamping Machine. Therefore A Tamping Machine performs following three functions:

- i. Correction of Alignment
- ii. Correction of longitudinal and cross levels, and
- iii. Packing under the sleepers



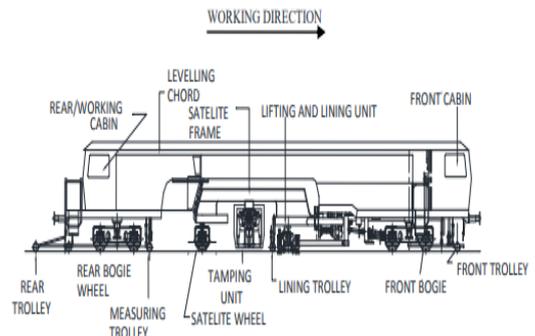
**Fig.1.2. – Process of rail tamping**



**Fig.1.3.-Postion of sleeper before and after tamping**

**V. GENERAL LAYOUT AND IMPORTANT UNITS OF A TAMING MACHINE**

A general layout of a tamping machine is given below:



**Fig.1.4. – General Layout Of a tamping machine**

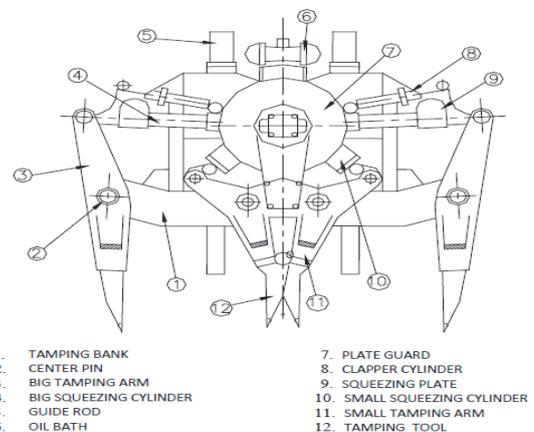
**VI. MAIN ASSEMBLIES OF TAMING MACHINES**

**(a) ENGINE:**

The main source of power is the diesel engine. An engine covert chemical energy of the fuel into mechanical energy which can be used further used for working of the machine

**(b)TAMPING UNITS:**

A Tamping machine is furnished with at least two Tamping unit with it. The packing unit are cinched on the machine outline through vertical guide segment. In some packing machines, the packing units are fitted to the satellite casing. Indian railroad can pack one/two/three/four sleepers one after another relying on kind of the packing machine. The apparatuses are masterminded two by two and every one of the different sides of sleeper is packed by four such pairs. The units are hung on flat guide sections so as to slide sideways, which permit their programmed focusing over the rails in bends. Vibration of hardware is acquired by cylinder bars turned on unpredictable shaft driven by pressure driven engines. A layout of tamping unit is shown. The lifting and lowering of tamping units is obtained by means of a hydraulic tamping units lifting/ lowering cylinder. The insertion depth of tamping tools and squeezing pressure can be varied for different types of sleepers [4].



**Fig.1.5. - General layout of tamping unit**

**VII. TYPES OF TRACK TAMPING MACHINES**

Following are some important tamping machine on the basis of features models and capabilities on Indian Railways are as under.

**(a) PLAIN TRACK TAMPING MACHINES**

Generally these types of machine are better for plain track tamping. Following are its types-

- 08-16 Unomatic
- 08-32 Duomatic (Plasser/Russian)
- 09-32 Continuous Action Tamping Machine (CSM)

**(b) POINTS AND CROSSING TAMPING MACHINE (UNIMAT)**

This is primarily a points and crossing tamping machine. Following are its types-

- 08-275 Unimat
- 08-275-3S Unimat

**(c) MULTI-PURPOSE TAMPING MACHINE (MPT)**

This machine is designed for spot attention on plain track as well as point and crossing. A critical multipurpose tamping machine is given below.



**Fig.1.6. – Multi-purpose tamping machine**

**VIII. LITERATURE REVIEW**

A brief review of current status of research work carried out by various investigators is given below.

**Report No.24 of 2015 (Railways) Volume II [5]** Described about Review on 'Procurement and Utilization of Track Machines in Indian Railways'. This book on the basis of CAG report 2004 described about the load capacity of all passengers and goods train and on the basis of that it estimated the cost of maintenance of track and machine. Price of imported tamping machines and their running costs calculated. Track Machine Directorate at Railway Board and TMOs at zonal level are dedicated wings responsible for procurement and monitoring of utilization of track machines. Based on the findings of the review, following recommendations are made for implementation:

- Railway Board needs to ensure that the distribution of track machines is made after judicious assessment of the requirement of the Zonal Railways so as to avoid

- holding of track machines in excess of requirement.
- Railway Board needs to frame a comprehensive action plan for indigenous development of track machines in a time bound manner.
- Targets for various track maintenance activities need to be realistic and fixed after due assessment of the workload of Zonal Railways.
- Track machines available in the Zonal Railways need to be optimally utilized to minimize the extra expenditure and unnecessary consumption of scarce maintenance blocks. Effective measures need to be taken to minimize idling of machines.
- Monitoring mechanism needs to be strengthened to ensure timely disposal of condemned machines.

**Indian Railways Institute of Civil Engineering [6]**

Described about mechanization of Indian railway and the import of tamping machine from Austrian company. It briefly described about the tamping process, various tamping machine which are imported from the foreign company. It gives the detail of all tamping parameters and general assembly of tamping machine.

Following are the details of cost of various tamping machine which India purchases from Plasser:

**Table 2.1 Indicative Cost of Machines.**

Sl. No.	Machine Type	Indicative Cost(Rs)
1.	CSM	20.08 Cr
2.	UNIMAT-4S	27.28 Cr
3.	DTS	9.85 Cr
4.	DUO	7.00 Cr
5.	MPT	6.93 Cr

It also provided following Preparatory Works before Introduction of Tamping Machines for Plain Track and Turnouts:

- Pre-tamping works need to be carried out before undertaking tamping of track by heavy on-track tamping machines.
- Operations During Tamping
- Post -Tamping Operations

**Research Design and Standards Organisation [7]**

Enforces standardization and co-ordination among various railway systems.

- RDSO is the sole R&D association of Indian Railways and capacities as the specialized guide to Railway Board Zonal Railways and Production Units and plays out the accompanying significant capacities:
- Development of better than ever structures.
- Development, appropriation, retention of new innovation for use on Indian Railways.
- Development of benchmarks for materials and items extraordinarily required by Indian Railways.
- Technical examination, testing and giving consultancy administrations.

- Inspection of essential and prosperity things of moving stock, trains, hailing and media transmission apparatus and track parts. RDSO diverse exercises have additionally stood out of railroad and non-railroad associations in India and abroad.

**Plasser & Theurer [8]** developed a motorized procedure for the arrangement of non-synchronous steady weight tamping which in proficient circles is viewed as spearheading and inconsistent in quality. The packing tines infiltrate the counterweight bed from above and smaller the counterbalance under the sleeper with a pressing development. Two variables are unequivocal here. Initially, all packing tines work with a similar weight; and also, the packing tines vibrate precisely at 35 Hz. This directional, straight vibration joined with the non-synchronous tine development delivers a homogeneously compacted stabilizer bed.

**Olja et al. [9]** created condition-based packing process in railroad building. With the end goal of this examination venture, a packing machine was furnished with various deliberately situated sensors so as to play out the in-situ estimations required to depict the association of the packing tines with the balance and its compaction underneath the sleeper. With a unique accentuation on the vitality moved into the weight and change of stabilizer solidness during compaction, ends concerning proficiency of the packing procedure in various balance conditions are made and introduced.

**Santos et al. [10]** built up an approach to characterize the ideal length of railroad track that would experience upkeep work by one packing machine. The procurement and calculated expenses related with the utilization of this sort of machine are important with regards to follow support. In any case, no orderly methodology was found in the writing that could assist directors with perceiving the machines' genuine limit, which is by all accounts progressively molded by the track's accessibility for support than by the machine's exhibition. The procedure introduced in this paper considers the execution limit of the machine in a situation in which the mediation plan is upgraded from a long haul point of view. It utilizes a procedure (reproduced toughening) to convey an advanced mediation plan and the model is applied to a few track length arrangements. An exchange off methodology is thusly embraced, standing up to the base calculated expenses with the fixed expenses of the machine. The usage of the calculation indicated huge cost decrease. This paper tends to the issue of computing the powerful track length that could be kept up by a packing machine. So as to accomplish this figuring, a methodological and a computational methodology was created. Besides, a numerical utilization of the proposed model was performed. The arrangement acquired for least unitary support cost ranges from 200 to 260 km length relying upon the fixed expense of the packing machine.

**Tan et al. [11]** examined and introduced a way to deal with anticipate packing viability utilizing closest neighbor classifier. The productivity of railroad support can be expanded by compelling packing. The forecast approach was surveyed and approved utilizing 10-overlap cross approval on genuine train information. It secures an exactness of around

70% when foreseeing packing adequacy one day before packing and 68% for 12 weeks before packing. This methodology will help numerous railroad tasks limit support costs, decrease impromptu personal time and dodge the expense of disappointment recuperation by knowing the conceivable packing viability early. Future work incorporates streamlining the methodology with more information, utilizing a weighted methodology just as a stacked classifier to improve the trust in the forecast.

The study uses the same time series database that was used in experiment. The study was conducted as follows:

1. Truncate the existing time series by the number of days before tamping. Locations with time series that are shorter than the truncated length are not considered. Algorithm is then used to predict the tamping effectiveness of the targeted location.

2. Repeat with different number of days before tamping, ranging from 0 to 84 days (12 weeks).

**Liu et al. [12]** proposed the necessities of increased train speed, wellbeing and progressively smooth and happy with voyaging are expanding firmly. This leads the need of prescient upkeep. Packing machines have been utilized for this reason. Packing machines available are for the most part precisely determined. Another using pressurized water driven packing gadget is proposed to conquer the confinements of precisely determined machines. Another sort of turning valve is additionally intended to improve the control of wavering packing chamber. Parametric examination is completed by building up mathematic model. The outcomes show that new alters can meet the structure prerequisite and the adaptable change of abundancy and recurrence is figured it out. It can defeat the swing issue of the clipping water powered chamber brought about by packing bar vibration.

Esveld [13] described in his book that track geometry composed of various components and each component has their specific property. These properties enables and supports the railway vehicle.

## IX. INFERENCES DRAWN FROM LITERATURE REVIEW

According to railway budget 2019, Indian railway have estimated the cost of Rs 2700 crore for railway safety and railway maintenance, it means that the railway is giving top priority to accident prevention measures. Tamping process is most important maintenance process. Therefore in reference with the research the above literature review is done. On the basis of above literature review following are the conclusions:

- The Indian railway wants to reduce its dependence on manual maintenance.
- Indian railway is opting for the latest technology to fix the same.
- For the latest technology Indian Railway purchased track tamping machines from Austria based company Plasser & Theurer. Plasser & Theurer established its unit in India and which is called as Plasser India.

Following are the machines which Indian Railway purchased from Plasser India unit:

1. Continuous tamping machine(CSM)
2. Tamping express(09-3X)
3. Track relay trains
4. Ballast cleaning machine
5. Ballast regulating machine
6. UNIMAT
7. DTS machines.
8. MPT

## X. RESULT AND DISCUSSION

From the conclusions of the literature review is clear that Indian railway purchase all tamping machine unit from the Plasser India private Limited (Foreign ownership).

Since the purchased tamping machines are very much costly Due to German standard technologies and monopoly of Plasser & Theurer in tamping machine market in maximum countries of the world. Therefore India started working on Indigenization of Tamping machines to reduce the cost of tamping machine.

Till now Indian railway has indigenized following tamping machine:

- Continuous tamping Machine(CSM)
- Tamping Machine-DUOMATIC
- Tamping Express (09-3X)
- Point And Crossing Tamping Machine(UNIMAT)

**Table.2. Cost analysis of tamping units.**

Sr. no.	Name of the machine	Purchased machine cost	Indigenized machine cost
1.	Continuous tamping Machine(CSM)	350 lakh	24 Lakh
2.	Point And Crossing Tamping Machine	300 Lakh	22 Lakh
3.	Tamping express	550 Lakh	40 Lakh

## XI. CONCLUSION

Now the Track and machine Central Periodic Overhauling Workshop North Central Railway Division Allahabad Is Starting Work on Project “Design and Development of Indigenized Multipurpose Tamping Machine.

This would be a great achievement and will create a way to Promote make In India programme.

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